DOCUMENT RESUME

ED 089 683 IR 000 395

AUTHOR Helwig, Carl
TITLE Educational Systems, Systems Approaches, and Educational Technology.
PUB DATE Apr 74
NOTE 4p.; Paper presented at the American Educational Research Association Annual Meeting (Chicago, Illinois, April 15 through 19, 1974)

EDRS PRICE MF-$0.75 HC-$1.50 PLUS POSTAGE
DESCRIPTORS *Educational Development; *Educational Planning; *Educational Technology; *Instructional Systems; State of the Art Reviews; *Systems Analysis; Systems Approach

ABSTRACT

Systems analysis and educational technology are powerful concepts, but to date their application to educational systems has been limited. The overall function of the systems analyst has yet to be defined and no operational or theoretical base has been created to support a technology of education or to justify its integration into school organizational theory. Educational technology has been largely restricted to hardware and materials, and system analysis techniques, while plentiful, have been applied chiefly in the area of educational planning. If the educational organization is considered as a system, then instruction must be regarded as the major subsystem. This being the case, the concepts of systems analysis and educational technology must be applied in systematic fashion to the design, implementation, and evaluation of instructional systems. (PB)

section # 4.15

U.S. DEPARTMENT OF HEALTH, EDUCATION & WELFARE
NATIONAL INSTITUTE OF EDUCATION
THIS DOCUMENT HAS BEEN REPRODUCED EXACTLY AS RECEIVED FROM THE PERSON OR ORGANIZATION ORIGINATING IT. POINTS OF VIEW OR OPINIONS STATED DO NOT NECESSARILY REPRESENT OFFICIAL NATIONAL INSTITUTE OF EDUCATION POSITION OR POLICY

Educational Systems, Systems Approaches, and Educational Technology

by

Carl Helwig

Old Dominion University

ED 089683

(A paper presented April 18, 1974 at the American Educational Research Association's annual meeting, Chicago, Illinois).

These indeed seem to be trying times for a possible marriage between systems analysis advocates, on the one hand, and the proponents of educational technology on the other. Definitions, preferably operational rather than purely literal, for such broad terms as systems analysis and educational technology, are hard to come by and after a rather thorough search of the literature, I had to settle for the limited interpretations below. However, my purpose here is not so much definitive as to rather assess the two trends and attempt a synthesis between three notions then, namely, educational organizations as systems, system approaches, and the impacts of what might fit under the broad umbrella of educational technology, as other than hardware, in the contexts noted below.

If any educational organization is to be regarded as a social system, then instruction should be its most important subsystem. From this vantage point, learning theorists and instructional material specialists have combined their interests to describe instructional systems (Bartley, 1968). However, systems concepts toward instructional technology vary widely as will be indicated below and both groups agree only upon one general theme, namely, that in the future, the level of the individualization of instruction will reach new heights previously thought unattainable.

Davitz and Ball define educational technology as "the application of a science of behavior to the practice of teaching" and this theoretical application of learning theory to act of teaching often sounds strained for the sole agreement among educational psychologists, including many neo-behaviorists, seems to be a sole tacit agreement that proper subject matter is the behavior of the learner. From thereon, no other discernible unanimity exists even among the neo-behaviorists and, at this point, it is even more unclear whether a behavioral orientation itself is dominant among American educational psychologists (Davitz and Ball, 1970). Gagne's definition of educational technology, too, is so broad as to yield little clarity, that is, "a body of knowledge about the systematic design and conduct of education band upon scientific research" (Gagne, 1974). From all this then, instructional design is still on an unexplored theoretical and research frontier (Gaettler, 1968). The function of the "educational designer" (or systems analyst) let alone his contribution to school organizational theory, thus has yet to be defined and no theoretical nor operational base for a science or technology of instruction exists. The curricular reform movement, encompassing such instructional innovations during the fifties and sixties as programed instruction, language laboratories, multimedia communication systems, and computer-assisted instruction stressed the need for a more systematic theory of instruction, but no known curricular movement to the present has shown that a technology of instruction would differ, if at all, from a theory of instruction. The instructional technology movement thus far has failed to develop a relevant theory as well as experimental evidence toward the justification for its integration into school organizational theory.

IR 000 395

Above I think I have demonstrated hardly any concordance between educational technology as a science, behavioral or otherwise, and instructional as well as learning theory and practice. However, in the area of educational planning and decision-making, the prospects look brighter. Unfortunately sound educational planning and decision-making can only proceed from and not precede sound instructional theory and practice. Thus the system analyst advocates seem a bit farther advanced than the curricular designers. If educational technology is to become "the application of a science of behavior," not only applied to the practice of teaching as defined by Davitz and Ball, but also to educational planning throughout, then the system analyst advocates do have several methodological approaches which do provide a scientific base in educational planning. Therefore, my own definition hereon of the term, educational technology, includes materials and hardware only indirectly.

Two unfortunate terms arise in the literature to confuse further the definitional problem, namely, system analysis and systems analysis. For the term, system analysis, a better term would have been systematic planning. That is all that it is--a deductive planning technique proceeding from a mission analysis to a functional analysis then to a task analysis and finally, at the end, a methods-means analysis. System analysis thus becomes a problem-solving, long-range, thinking process. Educational technology, as materials and hardware, does not enter into this deductive process except perhaps at the lowest level of planning, that is, the means-methods level, where implementation takes on its final role (Kaufman, 1972). Systems analysis, on the other hand, should have been identified as systematic analysis and thus the uncalled for confusion between system analysis and systems analysis avoided. To repeat: the mystical eruditeness of the system analysis advocates can be easily overcome by substituting two very familiar ideas into any endeavor, namely, systematic planning and systematic analysis. Under systematic planning then there would be actual assessments of educational needs and with this the concurrent identification of educational objectives, behavioral and otherwise, as well as educational requirements followed by a critical examination of all alternative courses of action. This last item would, moreover, consider resource costs and benefits, including utility theory, and most importantly, the explicit consideration of uncertainty which, wherever possible, must be reduced to propositions of probability. Several such methods or procedures exist through the system analysis advocates. I will now mention these before I conclude.

Three, the Delphi technique, Program Evaluation and Review Technique (PERT) and its close relative, the Critical Path Method (CPM), do involve planning and monitering and also do imfringe upon curricular planning, including educational technological hardware and material. The Delphi technique is a means to arrive at group consensus without the group meeting face-to-face. It thus eliminates open, time-wasting personal confrontations as well as nearly eliminating the tendency of the group to arrive at a group norm whenever some prestige figure particularly comes into dominance during the conference. In lieu of group face-to-face consensual thought or confrontations, with the Delphi technique a series of carefully designed questions, subject to several revisions as data is analyzed, are administered to a representative educational groups. Four general desired outcomes should be the results: anonymity, iteration, controlled feedback, and statistical group response. PERT and CPM allow for the planning and control of not only of budgetary matters, but the planning and control of curricular events, including behavioral (or instructional) objectives. Both methods are time-line, sequential graphic representations of milestones or events and could show the consequences of changes in implementation

activities, to include changes in time and resources and not only costs. Since curricular matters, like administrative matters, represent simultaneous, ongoing events, PERT and CPM provide for the planning, monitering, and controlling of complex curricular activities.

Operations research techniques with most system analysis advocates include PERT and CPM. However, here I will also mention several others which are easily applied to curricular matters: input-output analysis, decision tables and strategies, linear programing and queuing theory. The first two should involve no more than the ingenuity of their applications to curricular matters by curricular specialists. Linear programing, based upon linear regression analysis, has emerged as an important tool in the allocation of resources, including the human as well as time. Queuing theory seeks the reduction of waiting time in any complex activity and thus could include not only the reduction of human waiting time but also the non-use educational technological hardware.

Several other mathematical approaches also exist. To reduce uncertainty, probability theory, to include Bayesian probability, conditional probability, permutations, and combinations, aid in arriving at probability and thus predictive propositions. Close relatives to these are simulation and operational gaming. The first could include physical mockups, while the second complex, mathematical and computerized models with a multiplicity of interacting variables. Monte Carlo studies and track analyzes are two that stand out singularly. Finally, operational gaming is no more than another variation of simulation and is actually role playing.

Past, and even current administrative, decision-making applied summary data primarily for control and accounting, including, of course, curricular matters. Such an approach amounted to social bookkeeping in the enforcement of law and the legal distribution of allocated funds. Therefore, such data amounted to ex post facto or after-the-fact data for after-the-fact decisions. However, if decision-making is seen as the selection of choices from several alternatives, as do Griffith and Simon, then management becomes actively engaged in the educational process. With several such alternative courses of action identified, including educational objectives through needs assessment (Kaufman, 1972), then the Planning-Programing-Budgeting System (PPBS) technique becomes an important tool for its main forte is its ability in the determination of costs and benefits associated with each course of action. PPBS is closely allied to PERT and CPM techniques, for as indicated earlier with the latter two, PPBS is also a time-line, sequential, graphic representation of educational milestones or events.

Any systems cost analysis therefore becomes concerned with the cost evaluation of alternative courses of action. Three concepts, however, need be considered: (1) costing per re (2) utility (3) budgeting. The first, costing, extends beyond the consideration of dollar costs per unit, but also extends into the second concept, utility, or the payoff. Utility theory thus combines the psychological with the quantitative aspects of decision-making and hard cost data through experience should be available for such programs as special education, driver training and vocational education. Finally, with the third concept, budgeting, PPBS eliminates line item planning, such as instruction, plant operation, auxiliary services, administration, and fixed charges for the current fiscal year, and instead switches to educational program budget allocations, especially in the selection of solution strategies including, of course, cost-utility analysis.

Let me now summarize. Two terms, systems analysis and educational technology, are two broad generalities freely added to our ever-burgeoning educational vocabulary. I tried to give some precision to their meanings--a difficult task to say the least. Then I explained that tying the term educational technology, in connotations other than hardware or materials, to learning or instructional theory as well as practice has yet to become fruitful. From there, I tried to explain what such elusive terms as system analysis and systems analysis might mean to a school organizational theorist and how certain methodologies under the broad umbrella of systems analysis would give a better formulation for the synthesis of what the systems analysts advocate, on the one hand, and educational technologists on the other. Many of these methodologies are at least a decade old. Their applications to educational matters curricular rather than administrative call for no more than imaginative thinking by those engaged in curricular pursuits.

References

Banghart, F. W. Educational Systems Analysis. New York: Macmillan Company, 1969.

Davitz, J.R. and S. Ball. Psychology of the Educational Process. New York: McGraw-Hill, 1970.

Gagne, R. M., "Educational Technology and the Learning Process," Educational Researcher 3:1 (January, 1974), 3-8.

Hartley, H. J., "Systems Analysis in Education" in Educational Planning-Programing-Budgeting: A Systems Approach. Englewood Cliffs, New Jersey: Prentice-Hall, 1968.

Kaufman, R. A. Educational System Planning. Englewood Cliffs, New Jersey: Prentice-Hall, 1972.

Saettler, P., "Instructional Materials: Educational Media and Technology," Review of Educational Research 38:2 (April, 1968), 115-128.

Van Dusseldorp, R. A. and others, Educational Decision-Making Through Operations Research. Boston: Allyn and Bacon, 1971.